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(54) **SMART NOTEBOOK**

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G06F 3/0484	(2013.01)
G06F 3/0481	(2013.01)

(52) **U.S. Cl.**

CPC ***G06Q 10/10*** (2013.01); ***G06F 3/04815*** (2013.01); ***G06F 3/04847*** (2013.01)

(58) **Field of Classification Search**

CPC G06Q 10/109; G06Q 10/1095; G06Q 10/103; G06Q 10/1093; H04L 12/1822; H04L 12/1818

USPC 715/734, 753, 759, 864

See application file for complete search history.

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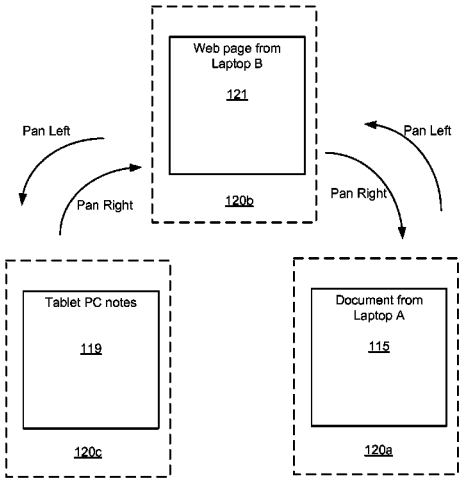
(57) **ABSTRACT**

Techniques are disclosed herein for allowing sharing of notes and ideas between electronic devices. The presence of a number of electronic devices is determined. A determination is made that the electronic devices are to be part of a shared workspace. A shared workspace is generated for the electronic devices. The shared workspace is displayed on a display screen of at least one of the electronic devices. The shared workspace that is displayed may be based on the capabilities of the electronic device. The shared workspace that is displayed may reflect the location of the electronic devices.

4 Claims, 12 Drawing Sheets



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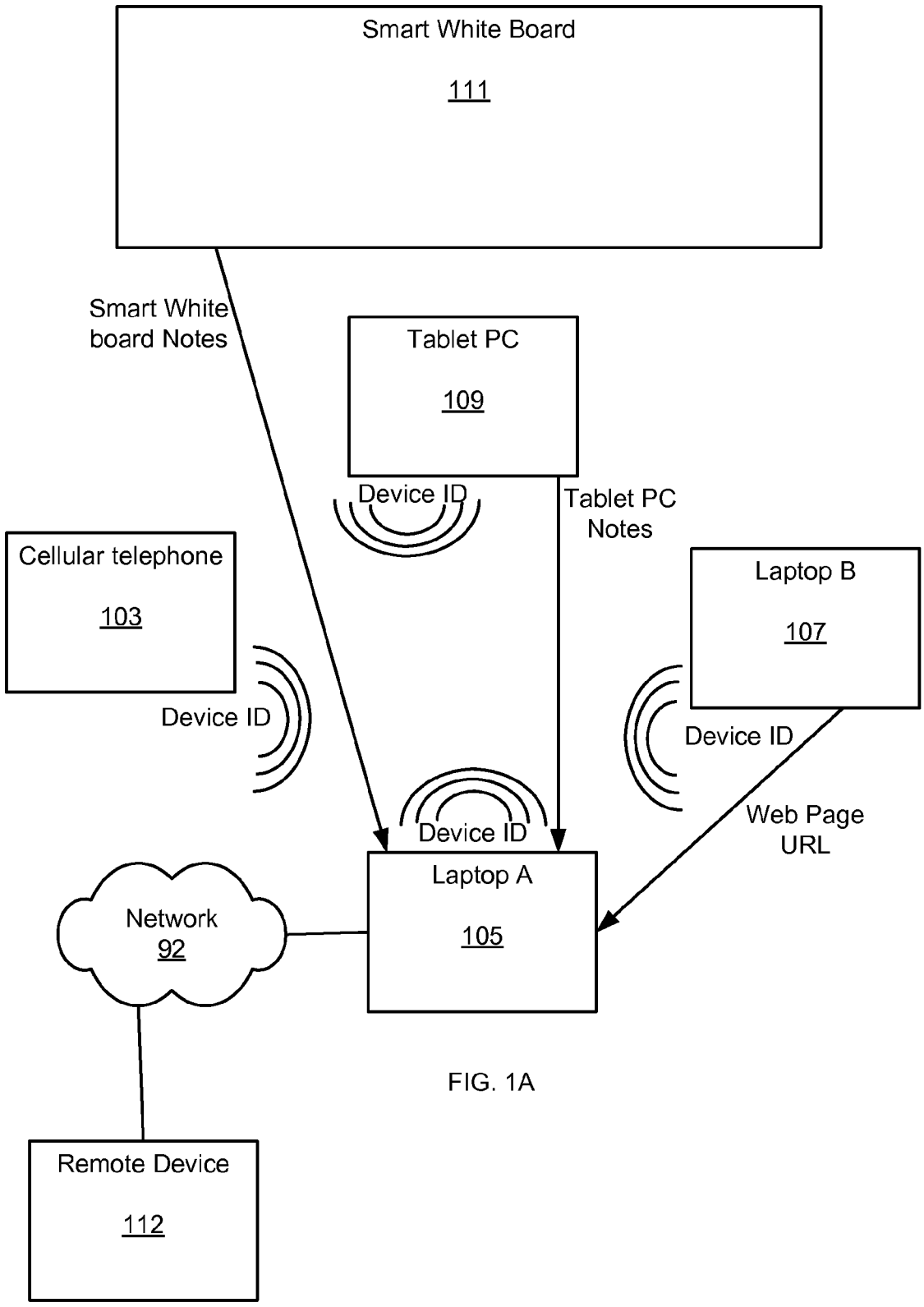
Smart White Board
111
Smart White board Notes
Tablet PC
109
Device ID
Tablet PC Notes
Cellular telephone
103
Laptop B
107
Device ID
Device ID
Device ID
Web Page URL
Laptop A
105
Network
92
Remote Device
112

FIG. 1A

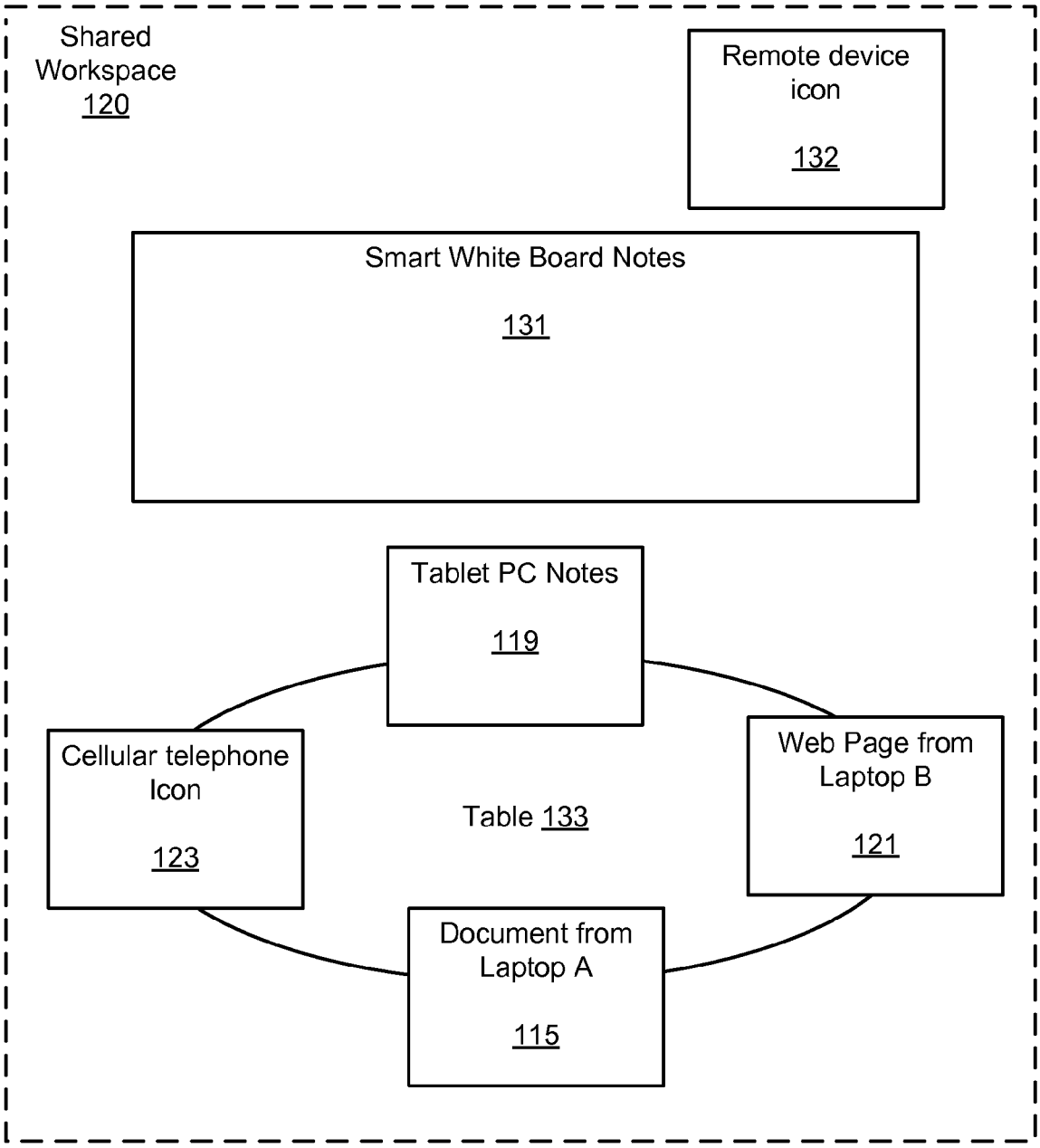
Shared Workspace 120
Remote device icon 132
Smart White Board Notes 131
Tablet PC Notes 119
Cellular telephone Icon 123
Table 133
Web Page from Laptop B 121
Document from Laptop A 115

FIG. 1B

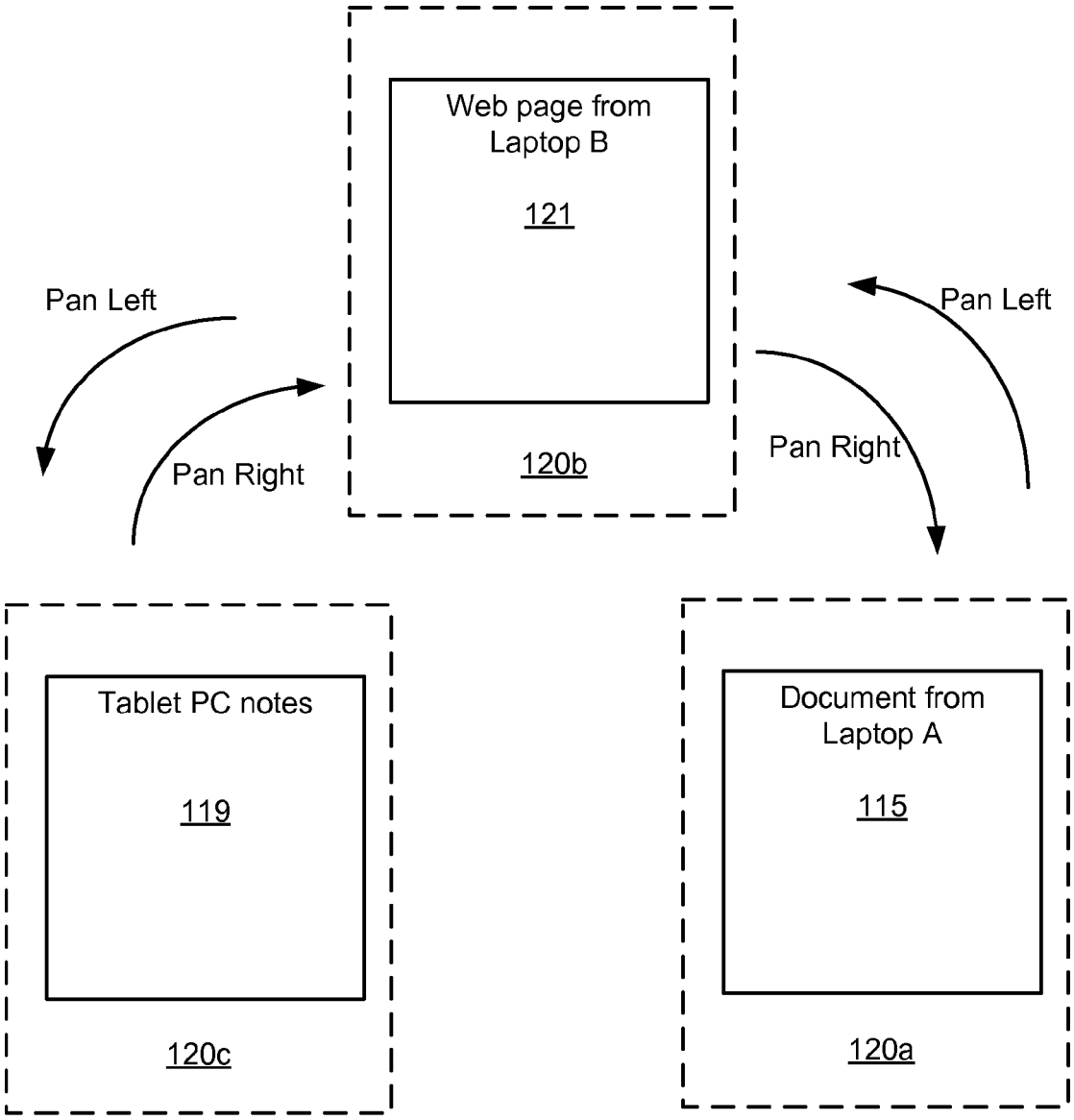
Web page from
Laptop B
121
120b
Pan Left
Pan Right
Pan Left
Pan Right
Tablet PC notes
119
120c
Document from
Laptop A
115
120a

FIG. 1C

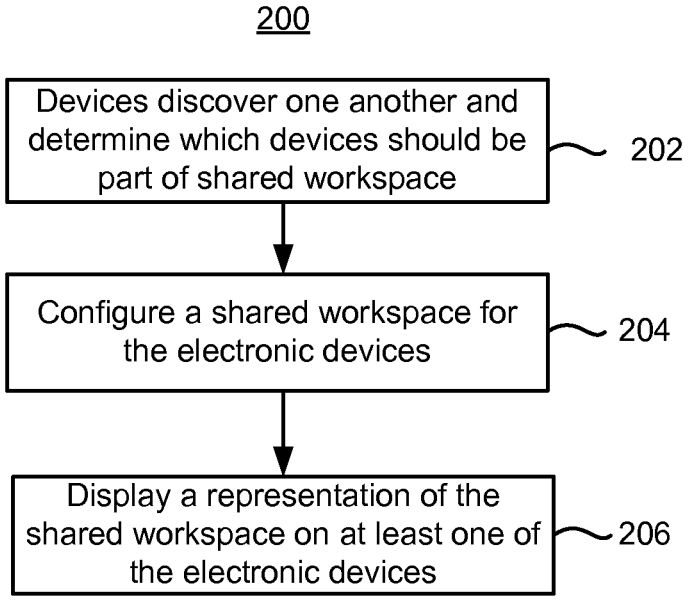
200
Devices discover one another and determine which devices should be part of shared workspace
202
Configure a shared workspace for the electronic devices
204
Display a representation of the shared workspace on at least one of the electronic devices
206

FIG. 2

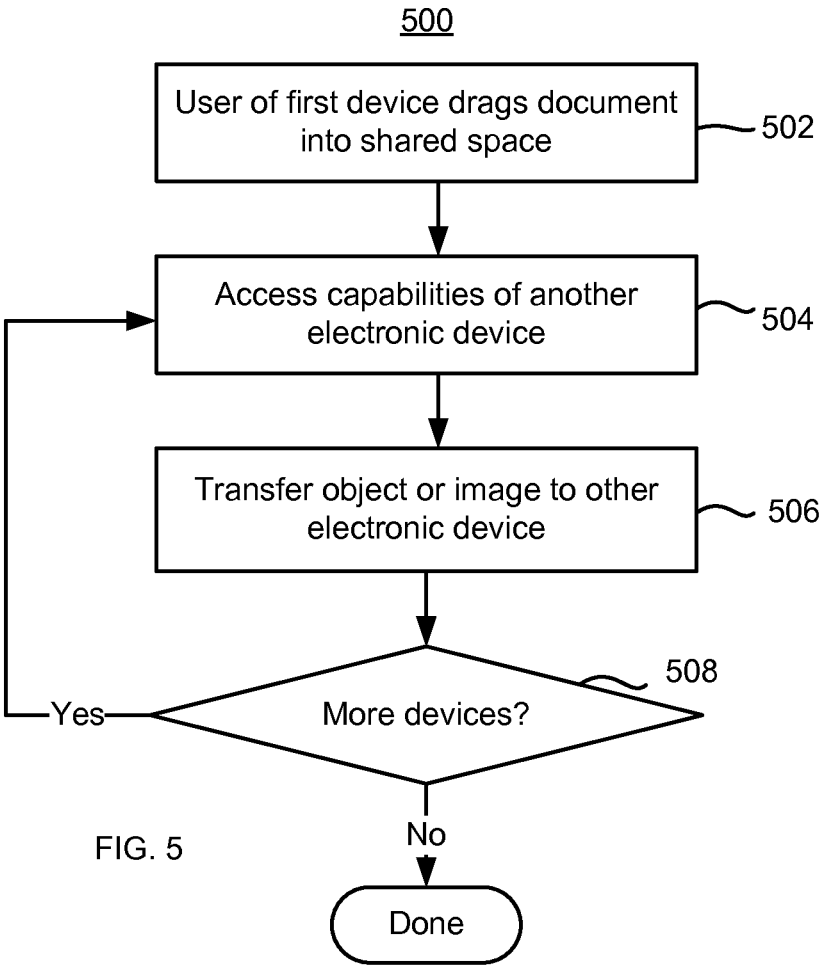
500
User of first device drags document into shared space
502
Access capabilities of another electronic device
504
Transfer object or image to other electronic device
506
More devices?
508
Yes
No
Done

FIG. 5

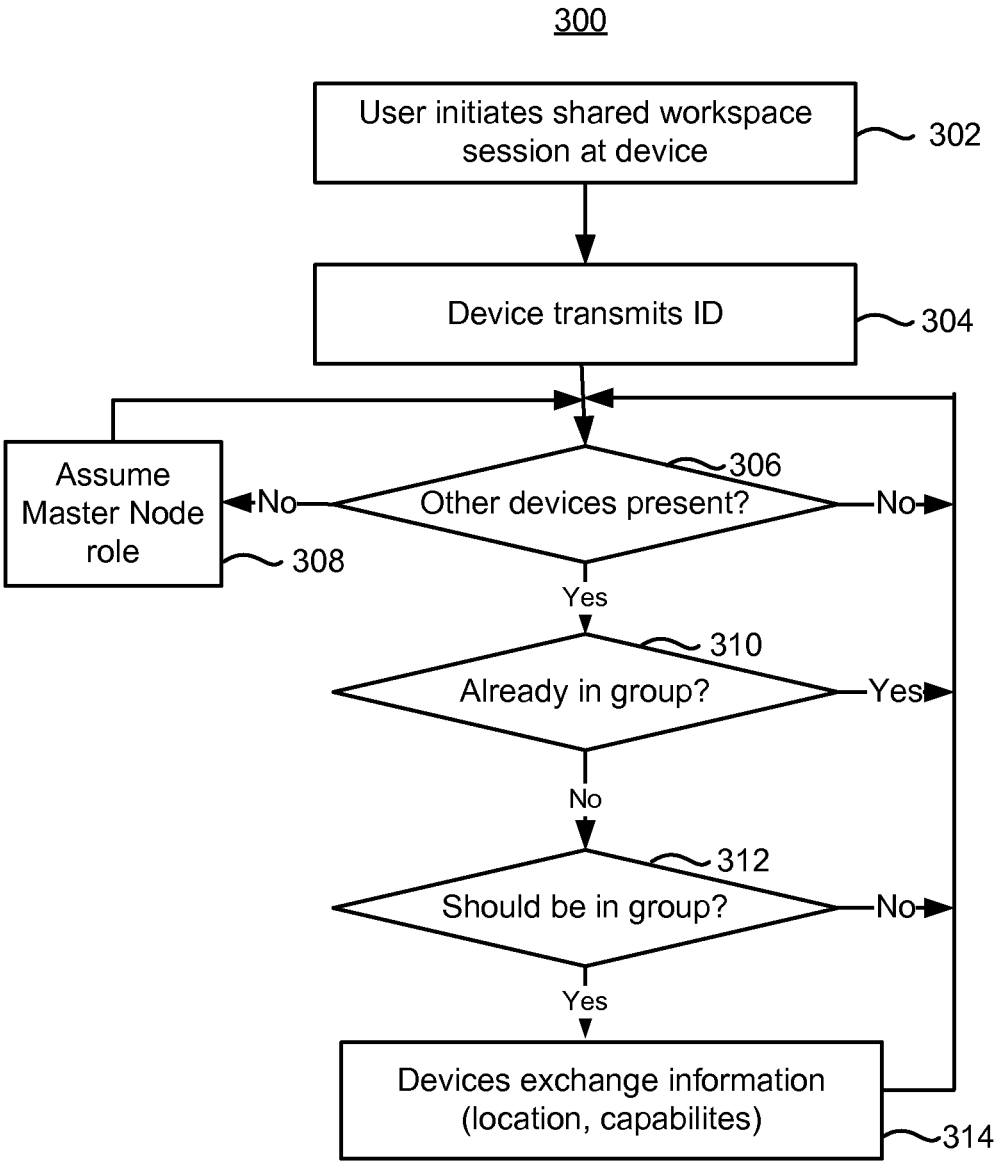
300
User initiates shared workspace session at device
302
Device transmits ID
304
306
Other devices present?
No
Assume Master Node role
308
Yes
310
Already in group?
Yes
No
312
Should be in group?
No
Yes
Devices exchange information (location, capabilites)
314

FIG. 3A

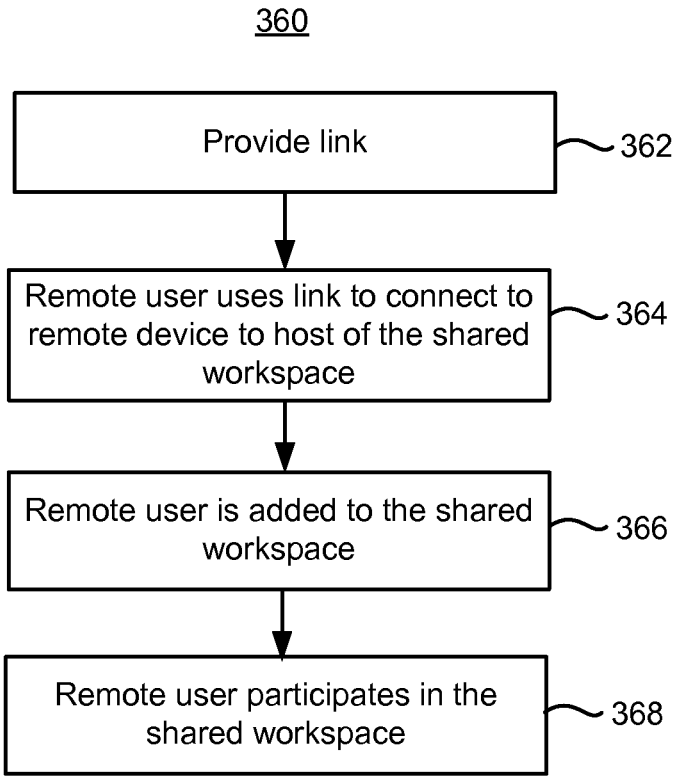
360
Provide link
362
Remote user uses link to connect to remote device to host of the shared workspace
364
Remote user is added to the shared workspace
366
Remote user participates in the shared workspace
368

FIG. 3B

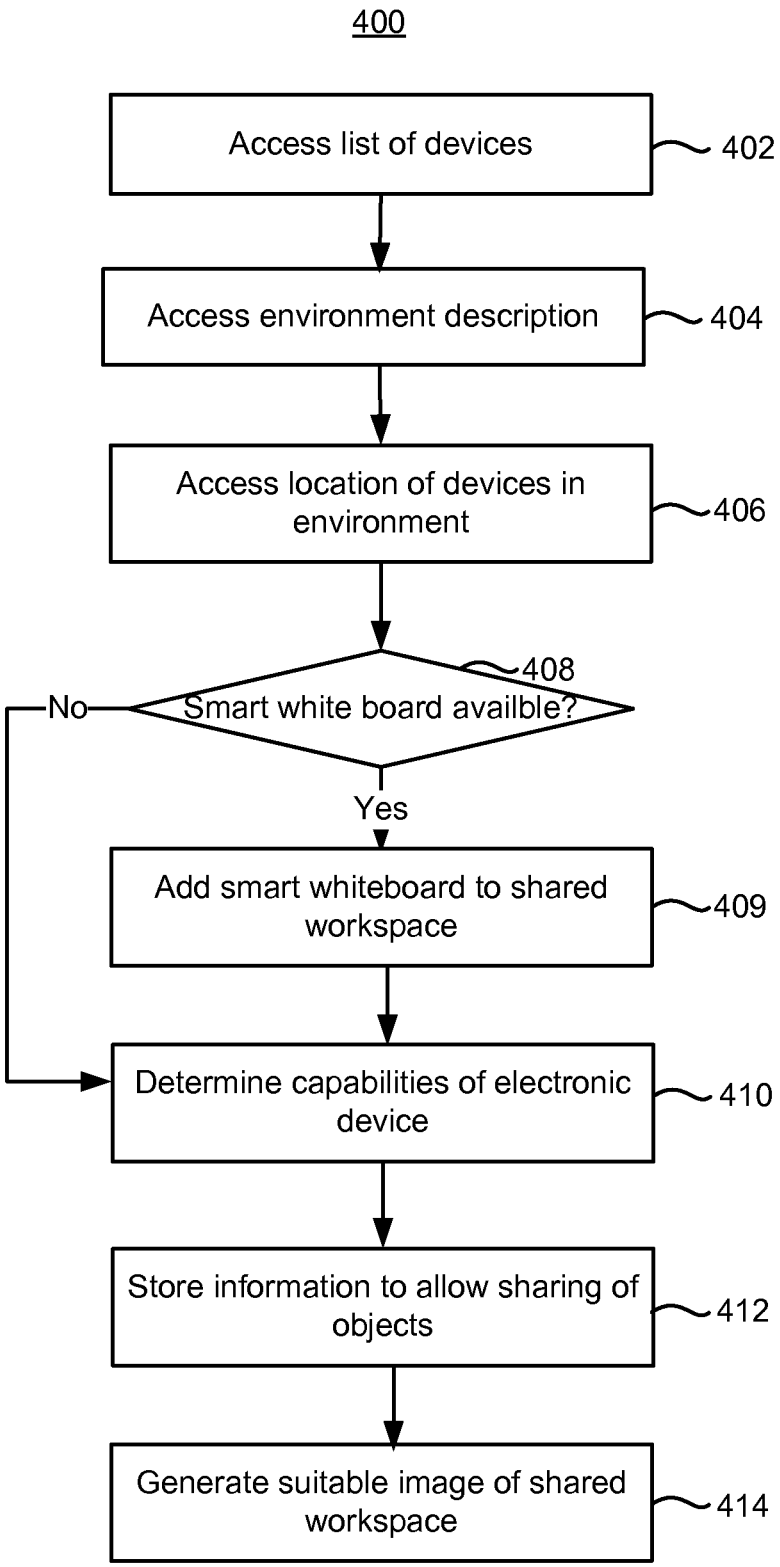
400
Access list of devices
402
Access environment description
404
Access location of devices in environment
406
408
Smart white board availble?
No
Yes
Add smart whiteboard to shared workspace
409
Determine capabilities of electronic device
410
Store information to allow sharing of objects
412
Generate suitable image of shared workspace
414

FIG. 4

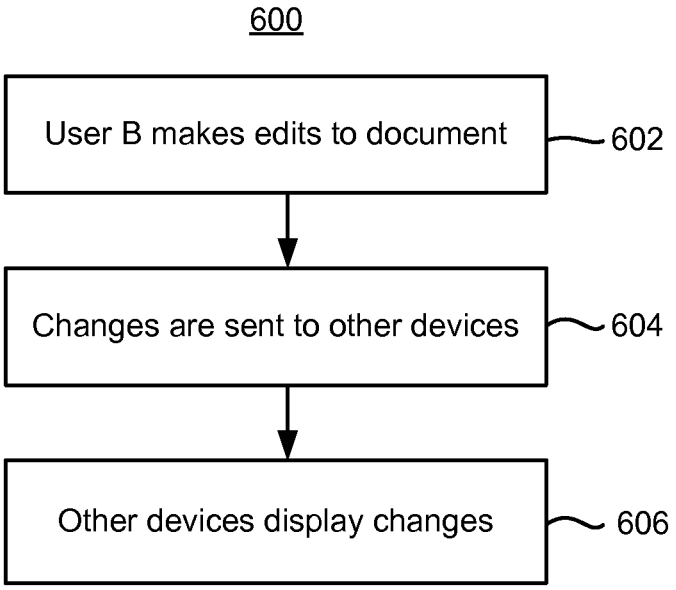
600
User B makes edits to document
602
Changes are sent to other devices
604
Other devices display changes
606

FIG. 6A

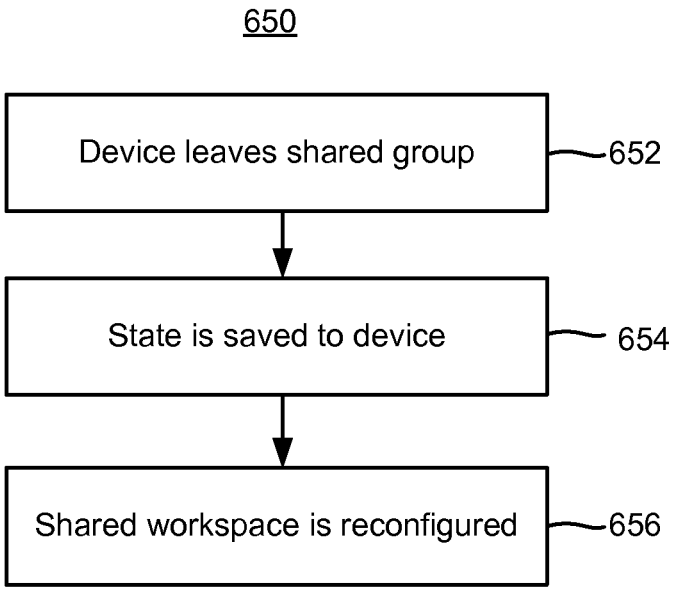
650
Device leaves shared group
652
State is saved to device
654
Shared workspace is reconfigured
656

FIG. 6B

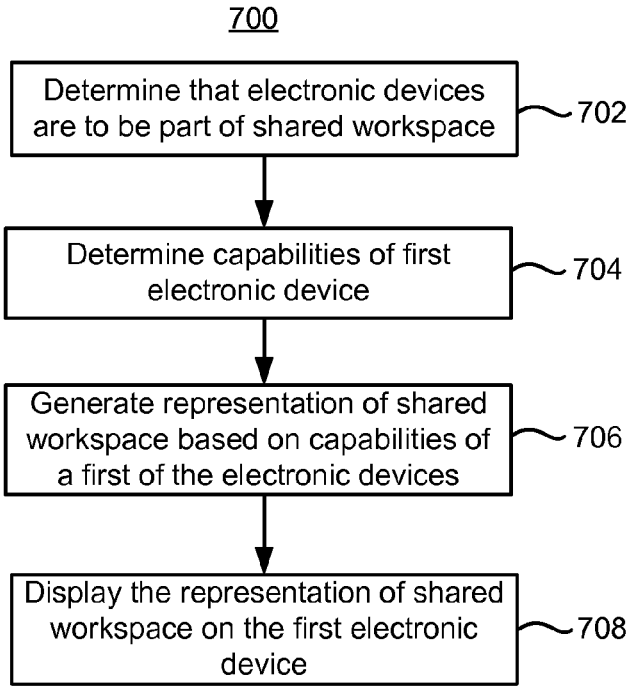
700
Determine that electronic devices are to be part of shared workspace
702
Determine capabilities of first electronic device
704
Generate representation of shared workspace based on capabilities of a first of the electronic devices
706
Display the representation of shared workspace on the first electronic device
708

FIG. 7A

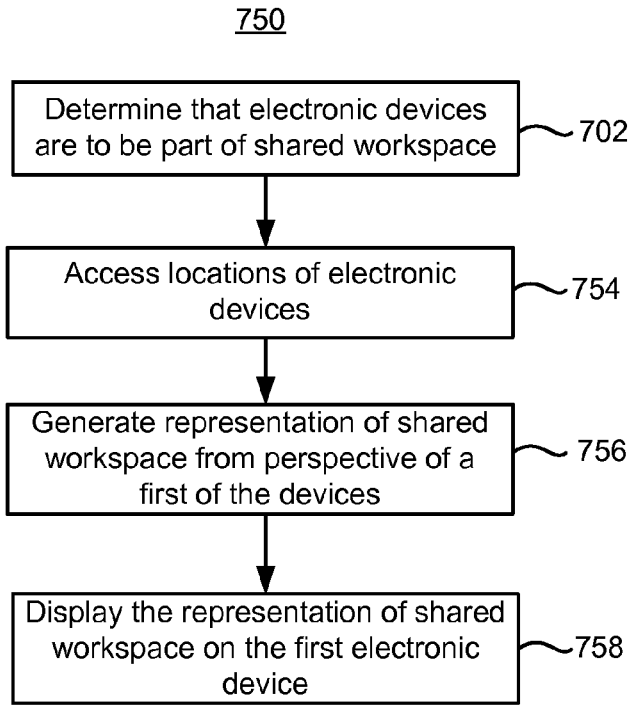
750
Determine that electronic devices are to be part of shared workspace
702
Access locations of electronic devices
754
Generate representation of shared workspace from perspective of a first of the devices
756
Display the representation of shared workspace on the first electronic device
758

FIG. 7B

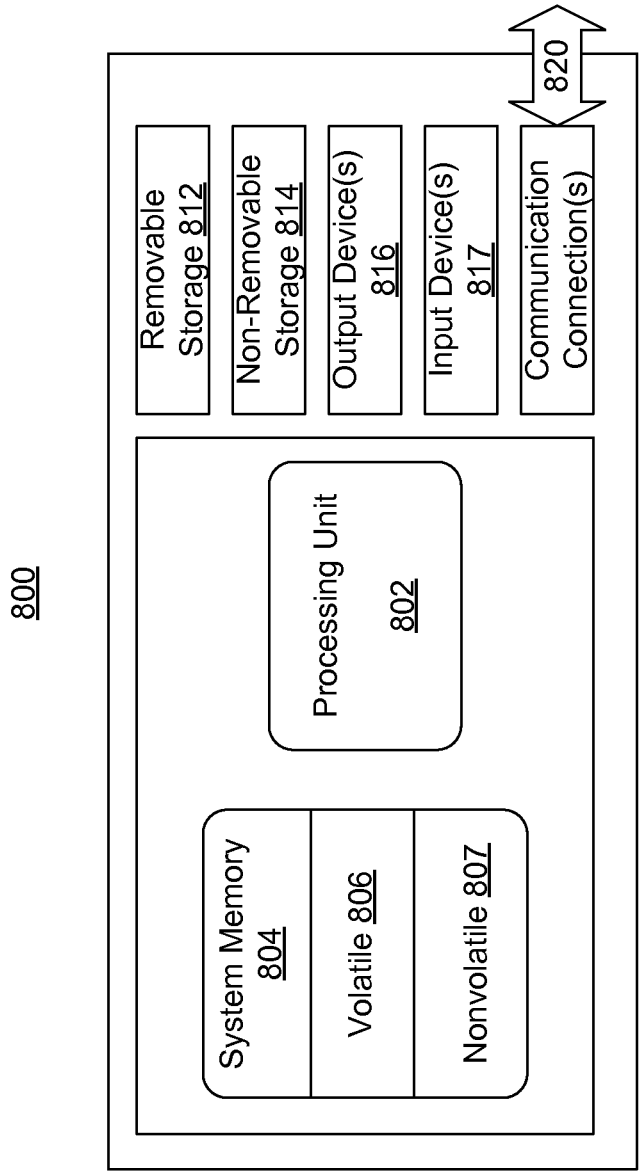
800
820
Removable Storage 812
Non-Removable Storage 814
Output Device(s) 816
Input Device(s) 817
Communication Connection(s)
Processing Unit 802
System Memory 804
Volatile 806
Nonvolatile 807

FIG. 8

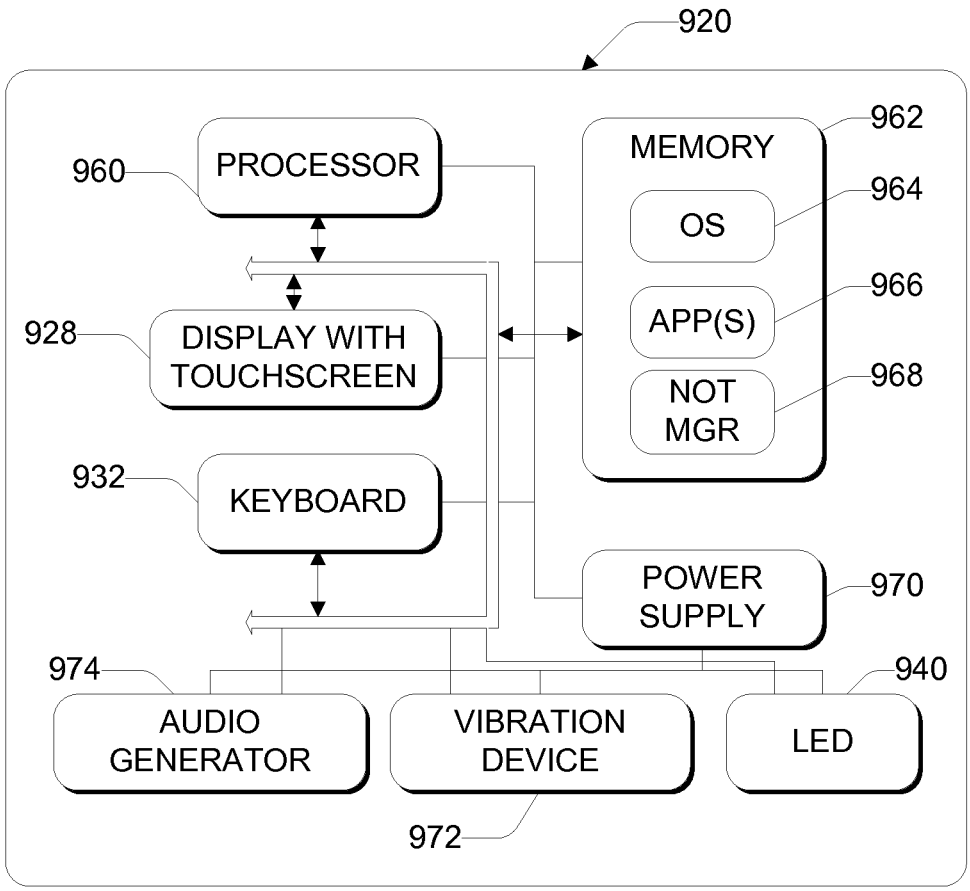
920
960
PROCESSOR
MEMORY
962
964
OS
966
APP(S)
928
DISPLAY WITH TOUCHSCREEN
968
NOT MGR
932
KEYBOARD
POWER SUPPLY
970
974
940
AUDIO GENERATOR
VIBRATION DEVICE
LED
972

FIG. 9

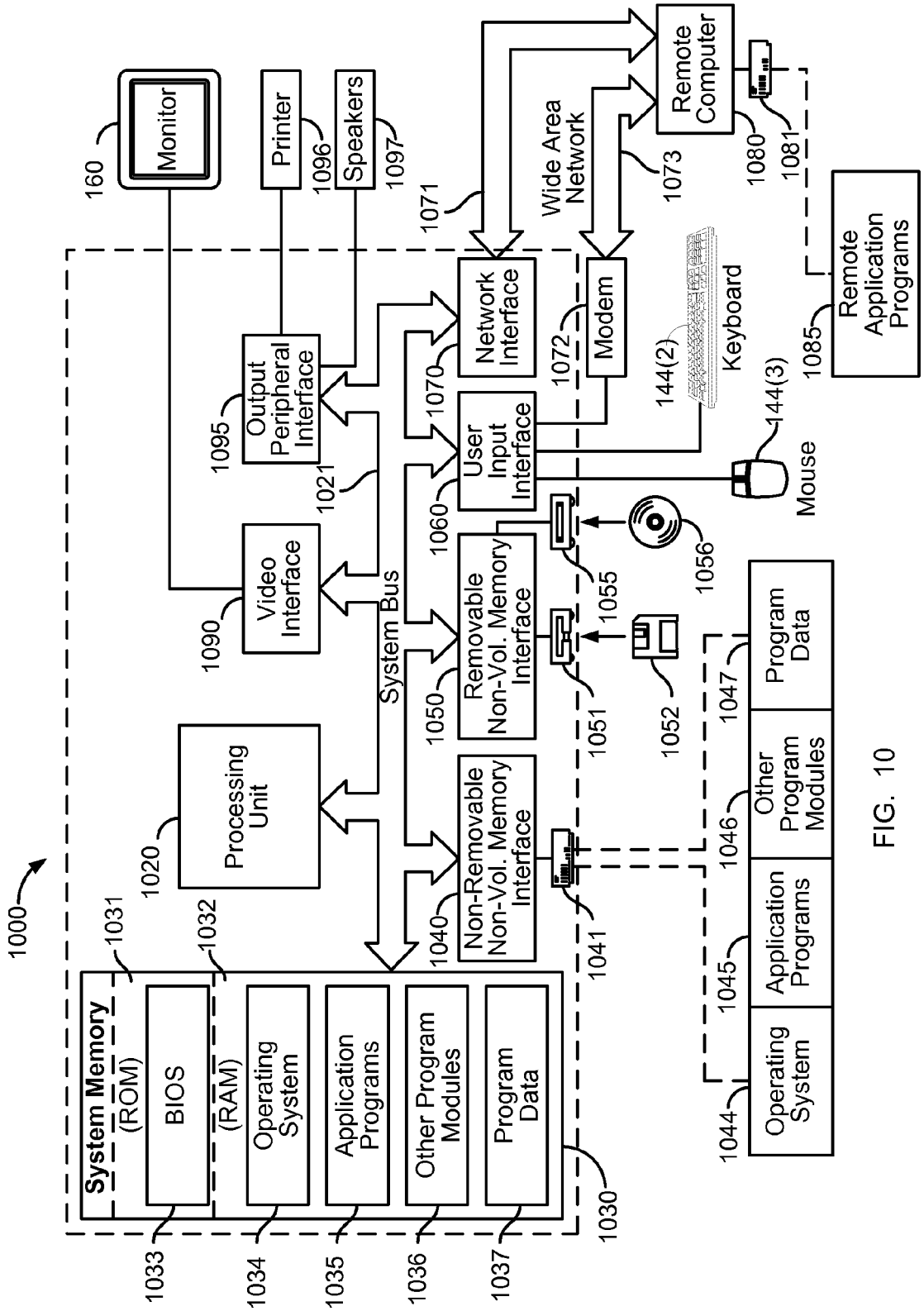
1000
System Memory
(ROM)
BIOS
(RAM)
Operating System
Application Programs
Other Program Modules
Program Data
1030
1031
1032
1033
1034
1035
1036
1037
Processing Unit
1020
System Bus
Video Interface
1090
Output Peripheral Interface
1095
Printer
1096
Speakers
1097
Monitor
160
Network Interface
1070
1071
Wide Area Network
Modem
1072
Remote Computer
1073
1080
1081
Remote Application Programs
1085
User Input Interface
1060
Keyboard
144(2)
Mouse
144(3)
Removable Non-Vol. Memory Interface
1050
1055
1056
Non-Removable Non-Vol. Memory Interface
1040
1041
1051
1052
Operating System
1044
Application Programs
1045
Other Program Modules
1046
Program Data
1047

FIG. 10

SMART NOTEBOOK

BACKGROUND

There are many settings in which individuals collaborate on ideas, projects, studying, etc. For example, meetings are held in business settings, students get together in classrooms or study sessions, etc. The meeting participants may bring a wide variety of electronic devices to the meeting. For example, a student might take notes on a laptop computer, many in the meeting may have a cellular telephone, or a group leader might use a computer to make a slide presentation. It can be desirable to allow the group members to use their electronic devices to share notes, share ideas, collaborate etc. However, there are numerous challenges with such sharing.

One challenge is to make the sharing process natural and easy. The following example will be used to illustrate some of the problems. A user can download a file from a personal computer to a portable storage device, such as a flash drive, and hand the flash drive to another person, who uploads the file to their computer. This technique suffers from numerous problems. For one, it can be very distracting to be physically passing the flash drive during a meeting. It may not even be practical to pass the device to someone who is on the other side of the room, or to pass the device to each person in the meeting. Also, there are security issues to deal with such as allowing only the desired file on the flash drive to be copied to other computers.

Some techniques provide for shared workspaces that allow users of different computers to collaborate. A shared workspace is an area where users can share documents and information, maintain lists of pertinent data, and keep each other up to date on the status of a group project. In some techniques, the shared workspace is hosted by a web server, which may be convenient when users are at different locations. However, such techniques may not allow users to have different views into the shared workspace.

Some shared workspaces allow the different users to collaborate in real-time. For example, the shared workspace allows a document, spreadsheet, or CAD drawing to be seen and modified by users at different computers. However, some real-time shared workspaces suffer from a limitation that all users see the same view, which may be referred to as "what you see is what I see" or "WYSIWIS."

SUMMARY

Techniques are disclosed herein for allowing sharing of notes and ideas between electronic devices. The techniques provide for a convenient and intuitive way to share in a collaborative setting. In one embodiment, electronic devices automatically discover one another and set up a shared workspace for the electronic devices. Thus, there is not a need for a web server or the like to set up and manage the shared workspace. Also, the automatic discovery process can determine which local electronic devices should and should not be allowed into the shared workspace such that a shared workspace can be conveniently established with a minimal amount of user intervention. The user's electronic devices may depict a representation of the shared workspace, thus showing the users who else is present and even showing their relative physical locations in the meeting.

One aspect is a machine implemented method for forming a shared workspace that includes the following steps. The presence of a number of electronic devices is determined. A determination is made that the electronic devices are to be part of a shared workspace. A shared workspace is configured for the electronic devices.

In one aspect, a computer readable storage device stores instructions which, when executed on a processor, cause the processor to implement a method that includes the following steps. A determination is made that a number of electronic devices are to be part of a shared workspace. A location of each of the electronic devices is accessed. A representation of the shared workspace that indicates the location of each of the electronic devices from the perspective of one of the electronic devices is determined. The representation of the shared workspace is presented on a display screen of one of the electronic devices.

One aspect is an apparatus having a display screen, a processor, and a computer readable storage device that stores instructions which, when executed on the processor, cause the processor to implement a method that includes the following. A determination is made that a number of electronic devices are to be part of a shared workspace. A representation of the shared workspace is generated based on capabilities of the apparatus. The representation of the shared workspace is presented on the display screen.

This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used as an aid in determining the scope of the claimed subject matter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1**A depicts an example environment in which users with electronic devices are meeting to collaborate.

FIG. **1**B depicts one embodiment of a shared workspace that is displayed on one of the electronic devices.

FIG. **1**C depicts one embodiment of three instances of shared workspaces that are viewed at the cellular telephone at different times by panning.

FIG. **2** is a flowchart of one embodiment of a process of configuring a shared workspace.

FIG. **3**A depicts a flowchart illustrating a process of discovering devices and determining what devices should be part of a shared workspace.

FIG. **3**B depicts one embodiment of a process for adding a remote user to the shared workspace.

FIG. **4** depicts one embodiment of a process of generating a shared workspace.

FIG. **5** depicts one embodiment of a process of adding objects to a shared workspace.

FIG. **6**A depicts one embodiment of a process for editing a document in a shared workspace.

FIG. **6**B depicts one embodiment of a process of an electronic device leaving a shared workspace.

FIG. **7**A depicts one embodiment of a process for generating a representation of a shared workspace based on capabilities of devices in the shared workspace.

FIG. **7**B depicts one embodiment of a process for generating a representation of a shared workspace based on capabilities of devices in the shared workspace.

FIG. **8** depicts an example computer system that serves as a platform for embodiments of the present invention.

FIG. **9** shows functional components of a handheld computing device that serves as a platform for some embodiments of the present invention.

FIG. **10** shows an example configuration of a computer that serves as a platform for some embodiments of the present invention.

DETAILED DESCRIPTION

Techniques are disclosed herein for allowing sharing of notes and ideas between electronic devices. The techniques provide for a convenient and intuitive way to share. In one embodiment, as users gather in a meeting room and turn on their electronic devices, the devices communicate with each other and automatically establish a shared workspace for the electronic devices. The shared workspace is depicted on one or more of the electronic devices to allow the user to easily see who is presently active in the shared workspace, as well as what other members are sharing. In some aspects, the depiction of the shared workspace represents the physical environment in which the users are collaborating, which allows the users to use the shared workspace in a natural and intuitive manner.

FIG. **1**A depicts an example environment in which users with electronic devices are meeting to collaborate. In this example, there are four local users (not depicted in FIG. **1**A) whose electronic devices are a cellular telephone **103**, Laptop A **105**, Laptop B **107**, and a Tablet PC **109**, and a remote user that is using remote device **112** to participate. The remote device **112** is connected to network **92**, which may be the Internet, a local area network (LAN) etc. The remote user might place a telephone call (connection not depicted in FIG. **1**A) in order to talk with the others. The local users might be sitting around a table, although the table is not depicted in FIG. **1**A. The electronic devices are depicted as broadcasting device IDs, which is one technique for the electronic devices to discover one another and establish a virtual workspace. Note that the device IDs might be transmitted point-to-point or point-to-multipoint, as opposed to being broadcast.

In some embodiments, the device IDs are transmitted using a technique that only allows devices that are relatively near each other to discover one another. For example, short range wireless communication may be used to transmit the device IDs. As an example, short range wireless communication may cover communication over distances that are typically less than 100 meters. However, in some cases, short range wireless communication may cover a greater distance such as up to 300 meters or more. Examples of short range wireless communication include, but are not limited to, infrared, Bluetooth®, and wireless local area network (WLAN). As an example, the Infrared Data Association (IrDA) publishes numerous specifications relating to infrared communication. Examples of WLAN are a set of IEEE 802.11 standards.

The workspace can be established with a very little effort on the part of the users, and can be dynamic in that as users enter and leave the meeting, devices are added and removed from the shared workspace. Herein, when referring to "electronic devices" it will be understood that this refers to the electronic devices that are to be a part of the shared workspace.

FIG. **1**A also depicts several objects (e.g., documents, files, web pages, URLs, etc.) being transferring to Laptop A **105** to represent the sharing with Laptop A **105**. In this example, the Tablet PC **109** is sharing notes that the Tablet PC **109** user is taking. Laptop B **107** is sharing a web page URL that is provided by the user of Laptop B **107**. The smart whiteboard **111** is transferring notes that are being taken on the smart whiteboard **111**. The remote device **112** might also share on object over network **92**. Other electronic devices also receive objects, but those transfers are not shown in order to not obscure the diagram. For example, Laptop B, the Tablet PC, and remote device **112** might also receive the notes from the smart whiteboard **111**. The objects might be transferred directly to a device or though another device. For example, smart white board notes might be transferred to Laptop A, and then on to remote device via network **92**.

The electronic devices may communicate with each other through any communication protocol and transmission medium. Typically, wireless communication is used, but wired communication may also be used. The communication may be point-to-point, point-to-multipoint or, in at least some cases, broadcast communication is used. In one embodiment, the electronic devices communicate using short range wireless communication. In some embodiments, one electronic device in the group serves as a master node that has communication channels to all other electronic devices, wherein the rest of the electronic devices communicate only with the master node. However, additional communication channels between the other electronic devices could be used.

The shared workspace may be hosted by one or more of the local electronic devices or a server, for example. At least some of the electronic devices may have a shared workspace software program that controls the discovery of the devices and subsequent formation of the shared workspace. The program may be a standalone program or a plug-in, as two examples. For example, the program might be a plug-in to a calendar program, a word processing program, etc. The program may store configuration information for the shared workspace, such as user permissions, devices in the shared workspace, communication settings, etc. Thus, the shared workspace program is able to manage the shared workspace. Therefore, a server or the like is not required to control the shared workspace, but may be used.

The electronic devices in Fig. **1**A are examples and are not intended to be limiting. The Tablet PC **109** is a portable electronic device that has a touchscreen or graphics tablet that allows user input via a stylus, digital pen, fingertip, etc. The graphics tablet (or digitizing tablet, graphics pad, drawing tablet) is a computer input device that allows the user to hand-draw images and graphics. The Tablet PC **109** may have handwriting recognition software, such that a text version of the handwriting may be stored and even transmitted to other electronic devices.

The smart whiteboard **111**, which may also be referred to as an interactive whiteboard, has technology that captures what is written or drawn on a surface of the board **111**. The smart whiteboard **111** may include software that analyzes the handwriting and translates it to text. The text may be stored in memory within the smart whiteboard **111**, as well as transmitted to another device. In various embodiments, the board surface may be written on with a marker, stylus, finger, or any type of pointing device. Thus, in some cases, the surface is written on, but can be cleaned and re-used. In other cases, no marks are made on the surface, but the smart whiteboard **111** is able to sense what is being written with, for example, a stylus, and generate a representation of what is sensed on a display screen. Thus, the surface of the smart whiteboard **111** may be a display screen.

The sensing technology that the smart whiteboard **111** may use to track interaction on the surface includes, but is not limited to, resistive, electromagnetic, infrared optical, laser, ultra-sonic, and camera-based (optical). Resistive touchscreens may be composed of two flexible sheets coated with a resistive material and separated by a thin air gap. When contact is made to the surface of the touch screen, the two sheets are pressed together, registering the location of the touch. Resistive technology allows one to use a finger, a

stylus, or any other pointing device on the surface of the board **111**. Optical and infrared technology may use triangulation to determine the location of a marker or stylus. Thus, optical and infrared technology allows the smart whiteboard **111** to be made of any material. Electromagnetic whiteboards **111** feature an array of wires embedded behind the board surface that interact with a coil in the stylus tip to determine the (x, y) coordinate of the stylus. Capacitive whiteboards **111** work with an array of wires behind the board **111**. If a person uses their finger to touch the screen, the wires detect a change in capacitance to calculate an (x, y) coordinate.

FIG. **1**B depicts one embodiment of a shared workspace **120** that is displayed on one of the electronic devices. The shared workspace **120** allows the users to share objects and to collaborate on them together. In this example, the shared workspace **120** is what is displayed on Laptop A **105**. The shared workspace **120** contains elements related to four local electronic devices, the remote device **112**, and the smart whiteboard **111**. In this example, the shared workspace **120** reflects the physical locations of the local electronic devices in the environment. Specifically, four users with electronic devices are depicted as gathered around a table **133**. The remote device **112** is set off to the top to indicate a remote participant. Note that it is not required that the shared workspace **120** reflect the physical location of the users or their environment. The workspace **120** is depicted from the perspective of the user of Laptop A **105** ("User A"). Thus, if User A were to look to the left, User A would see a user whose electronic device is a cellular telephone.

The shared workspace **120** depicts an element for each local and remote electronic device. Note that some of the electronic devices may be associated with a specific user, whereas other are not. For example, the smart white board **111** might not be associated with a particular user. Although clearly in some cases, the smart white board **111** might be associated with a user such as a teacher, group leader etc. Some of the users (or devices) are currently sharing with the group and hence the shared workspace **120** depicts elements to represent the object (e.g., document, notes, URL) being shared. The elements being shared correspond to what is being transferred to Laptop A **105** in FIG. **1**A. For example, the Tablet PC **109** is currently sharing notes with the group, and hence an element to represent Tablet PC notes **119** is displayed. This element might be a file that the can be accessed and edited, but that is not required. The element **119** might simply be an image of the Tablet PC notes, such that User A can view the notes. The user at Laptop B **107** is sharing a web page **121**, which Laptop A **105** could view by receiving the URL and accessing with a browser application. Alternatively, Laptop B **107** might transfer a copy of the web page. The user of the cellular telephone **103** is currently not sharing an object with the group. However, a cellular telephone icon **123** may be displayed to indicate that user's presence in the group. There is an icon **132** to depict the remote device **112**. Other information, such as user names may appear in the shared workspace **120**. One region of the shared workspace **120** shows the smart whiteboard notes **131**. User A at Laptop A is sharing a document and hence element **115** represents the document from Laptop A.

In some embodiments, the users are allowed to "zoom in" to take a closer look at the objects being shared. For example, User A might move a "cursor" to the element **121** of the workspace **120** depicting the web page and click on the web page to cause the web page to expand in size. Techniques for changing the level of image detail to allow zooming in and out are described in U.S. Pat. No. 7,133,054, titled "Methods and Apparatus for Navigating an Image," filed Mar. 17, 2004; Published U.S. Patent 2006/0267982, titled "System and Method for Exact Rendering in a Zooming User Interface," filed May 22, 2006; Published U.S. Patent 2008/0050024, titled "Method for Encoding and Serving Geospatial or Other Vector Data as Images, filed Sep. 19, 2007; and Published U.S. Patent 2007/0104378, titled "Method for Encoding and Serving Geospatial or Other Vector Data as Images, filed Dec. 29, 2006; all said patent documents are hereby incorporated herein by reference for all purposes. Note that techniques other than those described in the foregoing patent documents may be used for zooming in and out, as well as other rendering effects.

In some embodiments, a user may give permission to other users to edit a document being shared. For example, User A is sharing a document. By sharing the document, a copy of that document may be transferred to the electronic devices of other users. Note that some users might not get a copy because their device may not be able to work with the document. For example, the cellular phone **103** might get a bitmap image of the document instead. If given permission, User B may edit the document at Laptop B **107**. A synchronization process may be used to synchronize differences between the version of the document at Laptop A **105** and Laptop B **107**. It is not required that a synchronization process be used maintain the document being edited.

The following example will be used to illustrate how the shared workspace **120** of FIG. **1**B might be used; however, this example should not be viewed as being limiting. The shared workspace **120**, in the implementation of FIG. **1**B, is based on the physical environment in which the users are collaborating. For example, the shared workspace **120** depicts a table **133** in a conference room with indicators **115**, **119**, **121**, **123** of where each participant is sitting (at least where their electronic device is located). In this example, the indicators include an object being shared or an icon to represent the user. This provides for a very natural way for users to collaborate. If User A wishes to take a close look at the notes **119** that are being entered by the Tablet PC **109** user, User A knows where the Tablet PC **109** user is sitting and can quickly locate the notes **119** in the shared workspace **120**.

In the example of FIG. **1**B, the shared workspace **120** represents all of the electronic devices in the meeting. However, in some cases this may not be practical either due to the large number of devices in the meeting or the relatively limited capabilities of the electronic device. For example, a cellular telephone's limited size display screen might only display one object at a time. Alternatively, the cellular telephone **103** display might display multiple objects, but depict the objects at a reduced size. If the workspace **120** represents the physical space, then the cellular telephone **103** user can quickly locate a given workspace **120** object, even if the object is not current being displayed.

FIG. **1**C depicts one embodiment of three instances of shared workspaces **120***a-c* that are viewed at the cellular telephone **103** at different times by panning around. For example, at a given point in time, virtual workspace **120***b* depicts the web page from Laptop B **107**, which is across the table **133** from the cellular telephone user. Because the cellular telephone user knows that User A is sitting to the right of the cellular telephone user, the cellular telephone user can quickly pan to the right to find User A's object **115** in workspace **120***a*. The cellular telephone user can also pan to the left to view the Tablet PC notes **119** in workspace **120***c*. The user might pan also to view the smart white board notes **131** or remote device icon **132**. Thus, the user is allowed to pan left and right (or up/down, etc.) to change the view of the work-

space **120**. As the foregoing indicates, the way in which the workspace **120** is presented at a device may be based on the device's capabilities.

In some implementations, the shared workspace **120** has indicators for more than a single electronic device, but less than all of the electronic devices that are in the shared workspace. For example, the shared workspace might depict the web page **121** from Laptop B and icons to depict some, but not all, of the other electronic devices.

FIG. **2** is a flowchart of one embodiment of a process **200** of configuring a shared workspace **120**. In one implementation, process **200** is implemented by executing instructions on a processor. For example, Laptop A **105** may execute steps of process **200** by communicating with other electronic devices. In some cases, each electronic device separately executes steps of process **200**. In some implementations, a given device implements only a subset of steps in process **200**. For example, one device may act as a master node that performs certain steps for other devices.

In step **202**, electronic devices discover one another and determine which ones should be part of the shared workspace **120**. For example, as users enter a meeting room, the various electronic devices discover one another by broadcasting devices IDs. Based on the device IDs the electronic devices determine which ones are to be part of a collaborative group. Further details are described in process **300** of FIG. **3**.

In step **204**, a shared workspace **120** is generated for the electronic devices. The shared workspace **120** allows the devices to share objects such as application files, web page, etc. Step **204** may include one or more of the electronic devices in the group storing configuration information that is used in managing the shared workspace **120**. Further details are discussed in connection with process **400** of FIG. **4**.

In step **206**, a representation of the shared workspace **120** is displayed on at least one of the electronic devices. Initially, there may not be any objects being shared; however, an icon might be displayed for each electronic device in the group. The icons may reflect the physical location of each electronic device, but that is not required. FIGS. **1**B and **1**C depict example workspaces **120** that can be displayed on an electronic device. FIGS. **7**A and **7**B depicts two different embodiments of processes for generating and displaying a representation of a shared workspace.

FIG. **3**A depicts a flowchart illustrating a process **300** of discovering electronic devices and determining what devices should be part of a shared workspace **120**. Process **300** is one implementation of step **202** of process **200**. In step **302**, a user initiates a shared workspace session at a first device. For purposes of illustration, process **300** will be described from the perspective of actions at Laptop A **105**; however, it will be appreciated that other electronic devices could perform these actions instead. To initiate the session, User A may open a shared workspace software program on Laptop A **105**. The shared workspace program is capable of instantiating and managing the shared workspace **120**. Upon opening the shared workspace program, the program may automatically initiate certain steps of process **300**, such as broadcasting its device ID and discovering other electronic devices, although this is not required. The user may be requested to enter information such as a name for the shared workspace **120**, a User ID, password, etc. However, some of this information may be learned implicitly by the shared workspace program. For example, the shared workspace program may communicate with a calendar program to determine that the user is expected to be in a particular meeting at this time, thus inferring information therefrom.

In step **304**, Laptop A **105** broadcasts its device ID such that if there are already any other electronic devices active for the shared workspace group they will become aware of Laptop A **105**. The device ID can be any convenient identifier such as a MAC address, a user ID, etc.

In step **306**, Laptop A **105** determines whether any other electronic devices are currently present. For example, Laptop A **105** listens for a device ID of other devices. In some embodiments, a determination is made as to whether the other device is within short range wireless communication range. This is one technique for determining whether the other device is in close physical proximity.

If no other electronic devices are present, then Laptop A **105** may assume a master node role in step **308**. For purposes of discussion, Laptop A will be discussed as taking a master node role, but this is not a requirement. Next, Laptop A **105** continues to listen for other devices in step **306**.

If in step **306**, Laptop A **105** detects a device ID from another device, then Laptop A **105** determines whether the electronic device is already part of the shared workspace group (step **310**). If the electronic device is already part of the group, then no action is necessary. If the electronic device is not yet part of the group, process **300** continues at step **312**.

In step **312**, Laptop A **105** determines whether the new electronic device should be a part of the shared workspace **120**. In one embodiment, the devices perform an authentication process with each other to verify group membership. Laptop A **105** might have a list of users (or devices) that are permitted in the group and perform an authentication process to determine whether to allow the other device to join the shared workspace **120**. In some embodiments, this list is learned implicitly by, for example, communicating with a calendar program to determine who should be in the meeting. The list could also be manually entered at any time. If the new device is not recognized, the shared workspace program might issue an onscreen prompt to ask User A if the new device should be permitted into the shared workspace. If it is determined that the new device should not be a part of the group, then process **300** returns to listening for other devices in step **306**. Laptop A **105** might send a warning message to any current members of the group that an unauthorized device is present if authentication failed.

If the new device is to be added to the shared workspace **120**, then the devices exchange information such as their locations and capabilities (step **314**). The location information can later be used to generate a shared workspace **120** that depicts physical locations of electronic devices. The capabilities information can be later used to determine what type of information should be transferred to the other device. For example, the other device might receive an application file or an image that represents the content of the application file, depending on whether or not the device is capable or processing the application file.

Process **300** will now be described from the perspective of a device that is not the first to initiate the shared workspace **120**. As an example, this might be User B at Laptop B **107** starting a shared workspace program upon entering a meeting room. In step **302**, User B initiates a shared workspace session at Laptop B **107**. This may include User B opening a shared workspace software program in a similar manner to User A opening a shared workspace program. In one embodiment, upon opening the shared workspace software program, process **300** automatically continues at step **304** in which case the device broadcasts its device ID. In step **306**, Laptop B **107** determines that Laptop A **105** is already present and proceeds with step **310** to authenticate with Laptop A **105**. In some embodiments, Laptop A **105** assumes a master node role and

controls the authentication process. After determining that Laptop A **105** and Laptop B **107** should each be part of the group (step **312**), the devices exchange information (e.g., capabilities, location) in step **314**. It is not required that this information be stored at both Laptop A **105** and Laptop B **107**, but the configuration information may be stored at multiple devices.

When the user of the Tablet PC **109** enters the meeting, that user may also open a shared workspace program that may reside on Tablet PC **109** (step **302**). As with other devices, the Tablet PC **109** broadcasts its device ID (step **304**). The Tablet PC **109** determines that Laptop A **105** and Laptop B **107** are present (step **306**). The Tablet PC **109** might be informed that Laptop A **105** is the master node in which case Laptop A takes the lead in authenticating and other steps. Laptop A **105** determines that the Tablet PC **109** is not yet a part of the group (step **310**) and authenticates with the Tablet PC **109** (step **312**). Then, Laptop A **105** and the Tablet PC **109** exchange information (step **314**). This information may be shared with Laptop B **107**.

Adding the cellular telephone **103** to the shared workspace **120** may proceed in a similar manner to adding the other devices. Note that it is not required that each electronic device store a copy of a shared workspace program. For example, the cellular telephone **103** might not have a shared workspace program. Instead the cellular telephone **103** might rely on a device such as Laptop A to contact it, request information, and send it files occasionally.

FIG. **3**B depicts one embodiment of a process **360** for adding a remote user to the shared workspace. As previously mentioned, the shared workspace may be hosted by one or more of the electronic devices that are a part of the shared workspace, or another device such as a server. In step **362**, a link to the shared workspace is provided to the remote user. The link may be provided by numerous techniques including, but not limited to, the following. A link to the shared workspace may be posted on a website, sent to the remote user via electronic mail, or associated with an electronic meeting invite. An example of an electronic meeting invite is an invitation sent via a messaging and collaboration client such as Outlook® messaging and collaboration client, which is available from Microsoft Corporation of Redmond, Wash.

In step **364**, the remote user uses the link to establish a connection to a device that is hosting the shared workspace. For example, the user might enter the link into a web browser to connect to a server that is hosting the shared workspace. However, note that it is not required that a server host the shared workspace. It is not required that the remote device **112** have any special shared workspace software to establish the connection. The remote device **112** might be sent software, such as a lightweight client, to perform certain tasks such a render an image of the shared workspace and assist with data transfers to/from the device that is hosting the shared workspace.

In step **366**, the remote device **112** is added to the shared workspace. For example, an icon **132** of the remote device is added to the shared workspace **120** that is rendered at the other electronic devices. In some embodiments, the remote user is authenticated prior to adding to the shared workspace. The remote device may be queried for information such as display capabilities, etc, which may be stored at the host device.

In step **368**, the remote user participates in the shared workspace. For example, the remote user share objects with others in the shared workspace by data transfers to/from the host device.

FIG. **4** depicts one embodiment of a process **400** of generating a shared workspace **120**. Process **400** is one implementation of step **204** of process **200**. In this example, the shared workspace is based on information about the environment and the location of the electronic devices in the environment. However, this is not a requirement; hence it will be understood that not all steps of process **400** are required. Process **400** may be implemented on any of the electronic devices. In some implementations, multiple devices in the group perform this process **400**. For example, all devices could run their own software program to generate a shared workspace **120**. However, it is possible for one device to perform the process **400** and send information needed to display the shared workspace **120** on the other device. For the sake of discussion, an example of Laptop A **105** performing process **400** will be used.

In step **402**, a list of electronic devices in the shared workspace **120** is accessed. This list may be generated from step **202** of process **200**. In step **404**, a description of the environment is accessed. In one embodiment, the configuration of the room is stored in a database that is accessible to the shared workspace program. The identity of the room can be learned in a number of ways. For example, if the users set up the meeting using a calendar program, the calendar program may indicate the meeting time and room. The shared workspace program may communicate with the calendar program to learn the room number. Thus, the room number could be inferred by accessing the user's calendar and determining that the user is expected to be in a certain room at that time. Then, the shared workspace program accesses a database, possibly through a local area network, to obtain the room configuration. Of course, the room number could be learned in another manner, such as the user entering the room number. As another example, the room might be equipped with an RFID tag, which can be read to determine the room number.

In step **406**, the location of each of the electronic devices is accessed. This is an optional step. The electronic device's locations may be determined in a variety of ways. For example, an electronic device might have a RFID tag in it that allows its position to be determined by an RFID reader at a known location in the room. Alternatively, the user might enter information that describes the location, such as a seat number. This location information can be passed between electronic devices during the device discovery process **300**.

In step **408**, a determination is made as to whether a device such as a smart whiteboard **111** is in the environment. If so, the smart whiteboard **111** is added to the shared workspace **120** in step **409**. Adding the smart whiteboard **111** may include storing an indicator that the smart whiteboard is available such that an icon or other element can be added to the representation of the shared workspace that is displayed. Also, a reminder may be stored to request notes from the smart whiteboard **111** periodically. The smart whiteboard **111** is an example of a device that typically would not be brought into the meeting by a user. Other devices than a smart whiteboard **111** could also be added to the shared workspace in step **408**. In one embodiment, the devices that are added to the shared workspace **120** in step **408** are those that are not associated with a particular user. However, note that the smart white board and/or a device that is not associated with a particular user could be added to the shared workspace **120** during process **300**.

In step **410**, a determination is made as to the capabilities of this electronic device. For example, the screen size, rendering capabilities, and input capabilities are determined. Therefore, the shared workspace **120** can be adapted to the capabilities of the electronic device. As one example, the workspace pro-

gram on Laptop A **105** determines the capabilities of Laptop A **105**. As another example, the workspace program on Laptop A **105** performs at least some of the workspace management for other devices. In this case, the workspace program on Laptop A **105** determines the capabilities of another device such as the cellular telephone **103**. This information may have been passed during step **314** of process **300**.

In step **412**, configuration information for the shared workspace **120** is stored. In the present example, the configuration information is stored at Laptop A **105**. If Laptop A **105** is serving as a master node, at least some of the configuration information may be transferred to other devices, but that is not required. The configuration information may include any of the information learned so far, such as the electronic devices in the group, capabilities of each electronic device, device locations, etc. In some implementations, communication channels are established between electronic devices such that files and data may be passed between electronic devices. At this point, it is assumed that no electronic device has shared an object such as a document file yet. Process **500** below will describe adding an object to the shared workspace **120**.

In step **414**, a suitable image is generated for the shared workspace **120**. For example, an image depicts a table **133** with icons representing four electronic devices around the table is generated. There may also be a place for an icon for a smart whiteboard **111** and/or remote devices **112**. The image is displayed on at least one of the electronic devices taking part in the shared workspace. For example, Laptop A **105** displays the shared workspace **120**. Laptop A **105** may also generate a suitable image for another electronic device and transfer that image to the other device. Each image may be rendered from the perspective of the device displaying the shared workspace **120**.

FIG. **5** depicts one embodiment of a process **500** of adding objects to a shared workspace **120**. Process **500** may be performed by any of the electronic devices in the group. The object to be shared could be a file such as an application file, web page, a URL. However, note that sharing an object does not necessarily mean that a copy of the object is transferred. For example, when Laptop A **105** shares a document, a copy of the document might be transferred to Laptop B **107**, but a bitmap image of the document might be transferred to the cellular telephone **103**.

In step **502**, a user drags on object to be shared into a region of the display screen that causes objects to be shared. In one implementation, the user simply drags the object into a certain region of the screen that displays the shared workspace **120**. However, the object could be dragged into a different region.

In step **504**, the electronic device accesses the capabilities of other electronic devices to determine what to transfer to another electronic device in the group that is to receive an update. For example, Laptop A **105** determines that Laptop B **107** has the capability to edit a text document. Therefore, Laptop A **105** determines the Laptop B **107** should be transferred a copy of the text document. In one embodiment, first a check is made to determine whether User A grants permission to User B to edit the text document. That is, a copy of the text document could be transferred to look at, but User B could not edit the document (at least User B could not affect the copy located at Laptop A **105**). As another example, Laptop A **105** determines that the cellular telephone **103** is not able to edit the text document. Therefore, the cellular telephone **103** might be transferred a bitmap image of the text document.

In step **506**, an object is transferred to the other device to update its shared workspace **120**. If there are more electronic devices in the workspace **120** (step **508**), then process **500** continues at step **504**. Otherwise, process **500** concludes.

FIG. **6**A depicts one embodiment of a process **600** for editing a document in the shared workspace **120**. Process **600** refers to an example in which User B (at Laptop B **107**) edits a document that User A shared. However, the principles can be applied to other situations. Process **600** may begin at any point after User A has added the document to the shared workspace **120**. In step **602**, User B makes edits to the copy of the document that exists at Laptop B **107**. For example, Laptop B **107** has a word processing program that is used to edit the text document.

In step **604**, changes made by User B are sent to other electronic devices. The manner in which changes are made may depend on how the document is currently being displayed at other devices. For example, Laptop B **107** and Laptop A **105** may undergo a synchronization process to synchronize the versions of the text document at Laptop A **105** and Laptop B **107**. Afterwards, a version of the text document at the Tablet PC **109** may be synchronized. On the other hand, if the cellular telephone **103** is displaying a bitmap image, then a new bitmap image might be sent. If Laptop A **105** is functioning as a master node, Laptop A **105** might handle the updates to the Tablet PC **109** and the cellular telephone **103**. However, the electronic device that made the changes (Laptop B **107** in this example) could initiate the updates instead.

Note that the frequency with which the edits are sent can vary widely from one implementation to the next. It is of course possible for two users to make edits to different versions of the document between synchronizations. In such a case, a priority scheme may be used to determine which edits take precedence. As an example, any conflicts to edits made by User A and User B can be resolved in favor of the document owner (e.g., User A). Also, note that it is not required that a synchronization process be used. In one implementation, the edits are made to the shared document by Laptop B **107** transferring commands to Laptop A **105** that instruct what changes are to be made.

In step **606**, the electronic devices display the updated version of the document. Note that not all devices need to receive and display the updates. For example, if the cellular telephone **103** is currently displaying the web page from Laptop B **107** (and not the document being edited), then the changes need not be sent to the cellular telephone **103**.

FIG. **6**B depicts one embodiment of a process **650** of an electronic device leaving a shared workspace **120**. Process **650** refers to an example in which User B (at Laptop B **107**) leaves the shared workspace. However, the principles can be applied to other situations. Process **650** may begin at any point. In step **652**, User B initiates steps to leave the shared workspace, such as inputting a request to the shared workspace program. In response to this, Laptop B sends a message to at least the master node, and possibly all electronic devices, that Laptop B is leaving the shared workspace. In another alternative, electronic devices are active in the shared workspace so long as they are transmitting a certain signal such as their device ID (or transmit the signal within a certain timeout period). Thus, Laptop B simply stops transmitting this signal to leave the shared workspace.

In step **654**, a state of the shared workspace is saved to Laptop B. The state may include any of the objects that are being collaborated on. User B may be provided an option as to which objects to save; however, objects could also be automatically saved. Thus, the latest version of the document from Laptop A could be saved at Laptop B. Whether this document is saved may be conditioned upon permission from

User A at Laptop A. For example, when User A initially shared the document, User A might have specified that other users could not save the document. The state information could include other information, such as which users took part in the meeting. In one aspect, the version of the state that is saved is based on the capabilities of the electronic device. For example, a cellular telephone may not have much memory so it may be desirable to limit what is saved.

In step **656**, the shared workspace **120** is re-configured to reflect Laptop B leaving. For example, any objects that were being shared by Laptop B might be removed from the shared workspace **120**. However, there may be an option that allows objects from Laptop B to continue to be shared after Laptop B leaves the group. Reconfiguring the shared workspace may include re-sizing and re-scaling the representation of the shared workspace **120** at the other electronic devices.

FIG. **7**A depicts one embodiment of a process **700** for generating a representation of a shared workspace **120** based on capabilities of electronic devices in the shared workspace **120**. In step **702**, a determination is made that certain devices should be part of the shared workspace **120**. In general, process **300** can be used to make this determination.

In step **704**, the capabilities of the electronic device upon which the workspace **120** is to be presented is determined. For example, Laptop A **105** determines its own capabilities or is sent the capabilities of the cellular telephone **103**.

In step **706**, a representation of a shared workspace **120** is generated based on the device capabilities. For example, for Laptop A **105** the workspace **120** might depict all of the devices in the group, whereas for the cellular telephone **103** the shared workspace **120** might be more limited.

In step **708**, the representation of the shared workspace **120** is displayed on the electronic device.

FIG. **7**B depicts one embodiment of a process **750** for generating a representation of a shared workspace **120** based on locations of electronic devices in the shared workspace **120**. In step **702**, a determination is made that certain devices should be part of the shared workspace **120**. In general, process **300** can be used to make this determination.

In step **754**, the locations of the devices upon which the workspace **120** is to be presented is determined. For example, Laptop A **105** determines its location and is sent the location of the other devices. The other devices may send their locations during step **314** of process **300**.

In step **756**, a representation of a shared workspace **120** is generated based on the device locations. Laptop A **105** might generate the representation not only for itself, but for other devices. Each representation is from the perspective of the device on which the workspace **120** will be displayed.

In step **758**, the representation of the shared workspace **120** is displayed on the electronic device. For example, for Laptop A **105** the workspace **120** might resemble that of FIG. **1**B. Note that a location based shared workspace **120** representation can also include the example of FIG. **1**C, in which the workspace **120** is limited to showing information from one device at a time. However, by panning right or left, the user is allowed to move in the workspace **120**; hence, it is location-based. In one implementation, location based generation of the representation of the shared workspace is combined with device capability based generation.

Note that it is possible to have multiple shared workspaces ongoing in the same room or other region in which the electronic devices of different shared workspace groups are in close physical proximity to each other. In such a case, electronic devices from one group can be securely kept from eavesdropping on the other group by a variety of techniques such as encrypting transmissions. The configuration of the groups can be kept separate by only allowing electronic devices with the correct device ID (or user ID, password) to take actively take part in the group.

In various embodiments, the electronic devices execute computer readable instructions that are stored on computer readable media. For example, process **200**, **300**, **360**, **400**, **500**, **600**, **650**, **700**, and/or **750** may be implemented by executing, on a processor, instructions that are stored on a computer readable storage medium. Computer readable media can be any available media that can be accessed by the electronic devices. By way of example, and not limitation, computer readable media may comprise computer storage media. Computer storage media includes volatile and non-volatile, removable and non-removable media implemented in any method or technology for storage of information such as computer readable instructions, data structures, program modules or other data. Computer storage media includes, but is not limited to, RAM, ROM, EEPROM, flash memory or other memory technology, CD-ROM, digital versatile disks (DVD) or other optical storage, magnetic cassettes, magnetic tape, magnetic disk storage or other magnetic storage devices, or any other medium which can be used to store the computer readable instructions and which can accessed by the electronic devices.

FIG. **8** depicts an example computer system **800** that may serve as a platform for embodiments of the present invention. For example, computer system **800** may serve as a platform for an electronic device such as a Laptops **105**, **107**, Tablet PC **109**, cellular telephone **103**, or other electronic device. In its most basic configuration, the computer **800** typically includes a processing unit **802** and memory **804**. Pending on the exact configuration and type of computing device, memory **804** may be volatile (such as RAM), non-volatile (such as ROM, flash memory, etc.) or some combination of the two. Additionally, computer **800** may also have mass storage (removable **812** and/or non-removable **814**) such as magnetic or optical disks or tape. In some embodiments, a shared workspace program is stored in nonvolatile memory **807** or storage **812**, **814** and executed on processing unit **802**. Shared workspace program might also be loaded in volatile memory **806** and executed on processing unit **802**.

Similarly, computer **800** may also have input devices **817** and/or output devices **816**. Other aspects of device **800** may include communication connections **820** to other devices, computers, networks, servers, etc. using either wired or wireless media. For example, the electronic devices may have a wireless network connection that allows them to access the Internet or another network. The electronic devices may also have communication connections between themselves.

FIG. **9** shows functional components of a handheld computing device **920** that may serve as a platform for some embodiments. It has a processor **960**, a memory **962**, a display **928**, and a keyboard **111** **932**. The memory **962** generally includes both volatile memory (e.g., RAM) and non-volatile memory (e.g., ROM, PCMCIA cards, etc.). An operating system **964** is resident in the memory **962** and executes on the processor **960**. The H/PC **20** includes an operating system, such as the Windows® CE operating system from Microsoft Corporation or other operating system.

One or more application programs **966** are loaded into memory **962** and executed on the processor **960** by the operating system **964**. Examples of applications include email programs, scheduling programs, PIM (personal information management) programs, word processing programs, spreadsheet programs, Internet browser programs, and so forth. In one embodiment, applications **966** include a shared workspace program.

The H/PC **920** also has a notification manager **968** loaded in memory **962**, which executes on the processor **960**. The notification manager **968** handles notification requests from the applications **966**.

The H/PC **20** has a power supply **970**, which is implemented as one or more batteries. The power supply **970** might further include an external power source that overrides or recharges the built-in batteries, such as an AC adapter or a powered docking cradle.

The H/PC **920** is also shown with three types of external notification mechanisms: an LED **940**, a vibration device **972**, and an audio generator **974**. These devices are directly coupled to the power supply **970** so that when activated, they remain on for a duration dictated by the notification mechanism even though the H/PC processor and other components might shut down to conserve battery power. The LED **940** preferably remains on indefinitely until the user takes action. The current versions of the vibration device **972** and audio generator **974** use too much power for today's H/PC batteries, and so they are configured to turn off when the rest of the system does or at some finite duration after activation.

To make the drawing of FIG. **9** general to a variety of devices, not all components are depicted. The handheld computing device **920** could be used to implement a cellular telephone **103** with additional communication components.

With reference to FIG. **10**, an exemplary system for implementing some embodiments includes a general purpose computing device in the form of a computer **1000**. For example, computer system **1000** may be used to implement electronic devices such as Laptops **107**, **109**, personal computers, etc. Components of computer **1000** may include, but are not limited to, a processing unit **1020**, a system memory **1030**, and a system bus **1021** that couples various system components including the system memory to the processing unit **1020**. The system bus **1021** may be any of several types of bus structures including a memory bus or memory controller, a peripheral bus, and a local bus using any of a variety of bus architectures. By way of example, and not limitation, such architectures include Industry Standard Architecture (ISA) bus, Micro Channel Architecture (MCA) bus, Enhanced ISA (EISA) bus, Video Electronics Standards Association (VESA) local bus, and Peripheral Component Interconnect (PCI) bus also known as Mezzanine bus.

The system memory **1030** includes computer storage media in the form of volatile and/or nonvolatile memory such as ROM **1031** and RAM **1032**. A basic input/output system (BIOS) **1033**, containing the basic routines that help to transfer information between elements within computer **1010**, such as during start-up, is typically stored in ROM **1031**. RAM **1032** typically contains data and/or program modules that are immediately accessible to and/or presently being operated on by processing unit **1020**. By way of example, and not limitation, FIG. **10** illustrates operating system **1034**, application programs **1035**, other program modules **1036**, and program data **1037**. Applications programs **1035** may include a shared workspace program.

The computer **1000** may also include other removable/non-removable, volatile/nonvolatile computer storage media. By way of example only, FIG. **10** illustrates a hard disc drive **1041** that reads from or writes to non-removable, nonvolatile magnetic media and a magnetic disc drive **1051** that reads from or writes to a removable, nonvolatile magnetic disc **1052**. Computer **1010** may further include an optical media reading device **1055** to read and/or write to an optical media.

Other removable/non-removable, volatile/nonvolatile computer storage media that can be used in the exemplary operating environment include, but are not limited to, magnetic tape cassettes, flash memory cards, DVDs, digital video tapes, solid state RAM, solid state ROM, and the like. The hard disc drive **1041** is typically connected to the system bus **1021** through a non-removable memory interface such as interface **1040**. Magnetic disc drive **1051** and optical media reading device **1055** are typically connected to the system bus **1021** by a removable memory interface, such as interface **1050**.

The drives and their associated computer storage media discussed above and illustrated in FIG. **10**, provide storage of computer readable instructions, data structures, program modules and other data for the computer **1000**. In FIG. **10**, for example, hard disc drive **1041** is illustrated as storing operating system **1044**, application programs **1045**, other program modules **1046**, and program data **1047**. These components can either be the same as or different from operating system **1034**, application programs **1035**, other program modules **1036**, and program data **1037**. Operating system **1044**, application programs **1045**, other program modules **1046**, and program data **1047** are given different numbers here to illustrate that, at a minimum, they are different copies.

A user may enter commands and information into the computer **1010** through input devices such as a keyboard **144**(**2**) and a pointing device **144**(**3**), commonly referred to as a mouse, trackball or touch pad. Other input devices (not shown) may include a microphone, joystick, game pad, satellite dish, scanner, or the like. These and other input devices are often connected to the processing unit **1020** through a user input interface **1060** that is coupled to the system bus **1021**, but may be connected by other interface and bus structures, such as a parallel port, game port or a universal serial bus (USB). A monitor **160** or other type of display device is also connected to the system bus **1021** via an interface, such as a video interface **1090**. In addition to the monitor, computers may also include other peripheral output devices such as speakers **1097** and printer **1096**, which may be connected through an output peripheral interface **1095**.

The computer **1000** may operate in a networked environment using logical connections to one or more remote computers, such as a remote computer **1080**. The remote computer **1080** may be another electronic device in the shared workspace. However, the remote computer **1080** could be a device that is not in the shared workspace such as a personal computer, a server, a router, a network PC, a peer device or other common network node, and may includes many or all of the elements described above relative to the computer **1000**, although only a memory storage device **1081** has been illustrated in FIG. **10**. The logical connections depicted in FIG. **10** include a local area network (LAN) **1071** and a wide area network (WAN) **1073**, but may also include other networks. Such networking environments are commonplace in offices, enterprise-wide computer networks, intranets and the Internet.

When used in a LAN networking environment, the computer **1000** is connected to the LAN **1071** through a network interface or adapter **1070**. When used in a WAN networking environment, the computer **1010** typically includes a modem **1072** or other means for establishing communication over the WAN **1073**, such as the Internet. The modem **1072**, which may be internal or external, may be connected to the system bus **1021** via the user input interface **1060**, or other appropriate mechanism. In a networked environment, program modules depicted relative to the computer **1000**, or portions thereof, may be stored in the remote memory storage device. By way of example, and not limitation, FIG. **10** illustrates remote application programs **1085** as residing on memory device **1081**. In some embodiments, remote application pro-

grams **1085** include a shared workspace program that is downloaded to computer **1000**. It will be appreciated that the network connections shown are exemplary and other means of establishing a communication link between the computers may be used.

While some embodiments are implemented by executing computer readable instructions that are stored on computer readable media, this is not a requirement in all embodiments. Some embodiments may be implemented in hardware or a combination of hardware and software. For example, at least some of the steps of process **200**, **300**, **400**, **500**, **600**, **650**, **700**, and/or **750** may be implemented within an ASIC. As a particular example, a portion of the electronic devices may be implemented with an ASIC.

Although the subject matter has been described in language specific to structural features and/or methodological acts, it is to be understood that the subject matter defined in the appended claims is not necessarily limited to the specific features or acts described above. Rather, the specific features and acts described above are disclosed as example forms of implementing the claims.

What is claimed is:

1. An apparatus comprising:

a display;

a processor coupled to the display; and

a computer readable storage media device coupled to the processor, the computer readable storage media device having computer readable instructions stored thereon, the instructions which when executed on the processor cause the processor to:

determine that a plurality of electronic devices that include the apparatus are to be part of a shared workspace that allows the electronic devices to share objects with each other, the apparatus uses short range wireless communications to locate the other electronic devices which are in close physical proximity to the apparatus;

access a physical location of each of the plurality of electronic devices;

receive a first object to be shared in the shared workspace by a first electronic device of the plurality of electronic devices;

receive a second object to be shared in the shared workspace by a second electronic device of the plurality of electronic devices;

generate a representation of the shared workspace based on capabilities of the apparatus and the physical locations of the plurality of electronic devices relative to the physical location of the apparatus, the generating a representation of the shared workspace including determining to include less than all of the plurality of electronic devices in the representation based on the capabilities of the apparatus, the included electronic devices are a first set of electronic devices;

present the representation of the shared workspace on the display, including displaying the first object but not the second object;

receive a request to pan the representation of the shared workspace to a physical location of an electronic device in the shared workspace that is not in the first set of electronic devices;

determine a new representation of the shared workspace based on the physical locations the plurality of electronic devices that satisfies the request to pan, a second set of the plurality of electronic devices that is different from the first set is included in the new representation; and

present the new representation of the shared workspace on the display in response to the request to pan, including displaying the second object but not the first object.

2. The apparatus of claim **1**, wherein the instructions which when executed on the processor cause the processor to receive a request to pan the representation of the shared workspace to a different physical location and to determine a new representation of the shared workspace based on the physical locations the plurality of electronic devices that satisfies the request to pan include instructions which when executed on the processor cause the processor to:

receive a request to pan to the right at time when the first object being shared by the first electronic device is being presented on the display of the apparatus;

determine that the second electronic device is to the right of the first electronic device from the perspective of the apparatus; and

determine that the second set includes the second electronic device responsive to the determination that the second electronic device is to the right of the first electronic device.

3. A method comprising:

determining, by an apparatus, that a plurality of electronic devices that include the apparatus are to be part of a shared workspace that allows the electronic devices to share objects with each other, wherein the apparatus uses short range wireless communications to locate the other electronic devices which are in close physical proximity to the apparatus;

accessing, by the apparatus, a physical location of each of the plurality of electronic devices;

receiving a first object to be shared in the shared workspace by a first electronic device of the plurality of electronic devices;

receiving a second object to be shared in the shared workspace by a second electronic device of the plurality of electronic devices;

generating a representation of the shared workspace based on capabilities of the apparatus and the physical locations of the plurality of electronic devices relative to the physical location of the apparatus, the generating a representation of the shared workspace including determining to include less than all of the plurality of electronic devices in the representation based on the capabilities of the apparatus, the included electronic devices are a first set of electronic devices;

presenting the representation of the shared workspace on a display of the apparatus, including displaying the first object but not the second object;

receiving a request to pan the representation of the shared workspace to a physical location of an electronic device in the shared workspace that is not in the first set of electronic devices;

determining a new representation of the shared workspace based on the physical locations the plurality of electronic devices that satisfies the request to pan, a second set of the plurality of electronic devices that is different from the first set is included in the new representation; and

presenting the new representation of the shared workspace on the display in response to the request to pan, including displaying the second object but not the first object.

4. The method of claim **3**, wherein the receiving a request to pan the representation of the shared workspace to a different physical location and to determine a new representation of

the shared workspace based on the physical locations the plurality of electronic devices that satisfies the request to pan includes:

receiving a request to pan to the right at time when the first object being shared by the first electronic device is being presented on the display of the apparatus;

determining that the second electronic device is to the right of the first electronic device from the perspective of the apparatus; and

determining that the second set includes the second electronic device responsive to the determination that the second electronic device is to the right of the first electronic device.

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